

INVESTIGATOR'S ANNUAL REPORT

National Park Service

All or some of the information provided may be available to the public

Reporting Year: 1998	Park: Shenandoah NP
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Name: David Nelms Phone: 804-261-2630 Email: n/a	
Permit#: SHEN1998N-203	
Park-assigned Study Id. #: unknown	
Project Title: Dating Of Ground Water In Shenandoah National Park	
Permit Start Date: Jan 01, 1999	Permit Expiration Date Jan 01, 1999
Study Start Date: Jan 01, 1995	Study End Date Jan 01, 2002
Study Status: Completed	
Activity Type: Research	
Subject/Discipline: Water / Hydrology	
Objectives: Determine age of ground water in Shenandoah National Park. Relate ground-water age to local hydrogeology and water-quality parameters. Determine ground-water age and water quality parameters under high and low flow conditions. Ground-water age is the time elapsed since precipitation entered the water table and was isolated from air.	
Findings and Status: Chemical and isotopic analyses were completed on 34 springs and 17 wells sampled in Shenandoah National Park in August-September, 1997. The analyses include major and minor-element chemistry, dissolved gases (nitrogen and argon), tritium (3H), chlorofluorocarbons (CFC-11, CFC-12, and CFC-113), sulfur hexafluoride (SF6), tritium/helium-3 (3H/3He), delta D and delta O-18 of water, delta S-34 of sulfate, and delta N-15 of nitrate. The 1997 data were collected under low-flow conditions in the Park. These data are being compared to an identical sampling conducted in April 1996 under high-flow conditions. Near the end of the September 1997 sampling, a precipitation event (approximately 6 inches of precipitation over several days) permitted repeated sampling of four springs over several weeks time to see the chemical and isotopic response of spring discharge to the transient in flow. The four springs were Lewis Spring, Furnace Spring, Byrd's Nest 3, and Browntown Valley Overlook Spring. The response varied between springs and between constituents measured. For example, the apparent recharge temperature based on nitrogen and argon concentrations fell about 7 oC for discharge from Byrd's Nest 3 following the (cooler) precipitation event. In contrast, the recharge temperatures of discharge from Browntown Valley Overlook Spring and Furnace Spring increased several degrees follow the event, while that from Lewis Spring was nearly unchanged. Silica concentrations showed almost no response to the precipitation event, but were all lower in discharge from the dry season relative to that measured during (wet) April, 1996. 3H/3He age showed little variation in response to the precipitation event, and was about 2.5 years for discharge from Byrd's Nest 3, 1 year for discharge from Browntown Valley Overlook Spring and 0-1 year for discharge from Lewis and Furnace Springs. The average recharge temperature of spring discharge f or all 34 springs sampled, based on nitrogen and argon data, was 10.5 +/- 2.2 oC in September 1997, compared to 8.1 +/- 1.4 oC from the April, 1996 data set. This indicates that dissolved gases exchange with the unsaturated-zone air and respond to seasonal temperature variations. CFC-11 concentrations in 1997 spring discharge decreased 10 percent from their 1996 values, while CFC-113 and CFC-12 concentrations decreased only 3 and 0.6 percent relative to their 1996 concentrations. Virtually modern ages were found for most spring discharge in 1997 based on CFCs, SF6, and 3H/3He dating. There was a slight bias to apparently slightly older ages in spring discharge during the dry season relative to that of the wet season, suggesting slightly older ages in base flow. Discharge from some wells could be interpreted as mixtures. For	

example, the combined use of CFCs and 3H/3He dating can be interpreted to indicate that discharge from the Dickey Ridge well contains 30-42 percent of water recharged in 1988 mixed with 58-70 percent of pre-1940's recharge water. Many of the wells near campgrounds and other Park facilities contain concentrations of CFCs in excess of that possible for air-water equilibrium and indicate local contamination. Although not harmful in any way, the results indicate that human activities in the Park can directly influence water sources in SHEN. We are still in the process of evaluating the chemical and isotopic data. Additional sampling is planned for 1999. This will include approximately hourly monitoring of discharge from Lewis Spring, Furnace Spring, Byrd's Nest 3, and Browntown Valley Overlook Spring for temperature, dissolved oxygen, specific conductance, and pH, with full chemical and isotopic sampling approximately monthly. Other sampling will include additional wells in the Park, and a selection of wells and springs at lower altitude surrounding SHEN. Monitoring of air for CFCs and SF6 at Big Meadows will continue.

For this study, were one or more specimens collected and removed from the park but not destroyed during analyses?

No

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Fill out the following ONLY IF the National Park Service supported this project in this reporting year by providing money to a university or college

Full name of college or university:

n/a

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